Estimating PM2.5 in the Northeast United States Using Kriging

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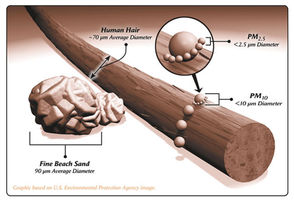
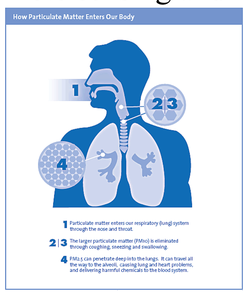
Background and Objectives

- PM2.5 is a form of particle pollution and is found primarily in smoke and haze.
- Particle pollution contains microscopic solids or liquid droplets that are able to enter deep into the lungs and cause serious health problems.
- $PM_{2.5}$ has been linked to increased respiratory symptoms and cardiovascular disorders.
- Our goals from the research project are to obtain kriging results with variance and to obtain fusion between remote sensing and kriging.



Approximate size of PM2.5



PM2.5 Health Effects

Materials and Method

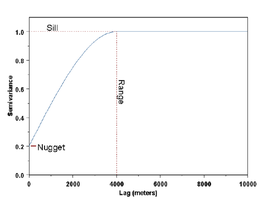
Data:

- AQS (Air Quality System, EPA) is a repository of ambient air quality data from over 10,000 EPA, state, local, and tribal pollution control agencies.

- RSIG (Remote Sensing Information Gateway, EPA) is a tool for selecting, sub setting, downloading, assembling, and visualizing environmental data. It renders each dataset and overlays them on a map.

Kriging

- Kriging, a method of interpolation, is based on regression against observed values of surrounding data points, weighted according to a covariance function.
- Simple kriging assumes the expectation of the random field to be known.
- If the data points are dense and uniformly distributed, we expect to obtain good results regardless of an interpolation algorithm.
- If the data points fall in a few clusters with large gaps in between, we expect to obtain unreliable estimates regardless of an interpolation algorithm.
- We expect best estimates when the PM2.5 values fall under a normal distribution.
- Kriging compensates for the effects of data clustering by putting more weight on isolated points and treating clusters like single points.
- The kriging algorithm will need to access to semivariograam values for lag distances other than those used in the empirical variogram.
- Semi variogram models used need to obey certain numerical properties for the kriging equations to be solvable.
- We used the spherical model, which exhibits linear
- behavior at the origin, appropriate for representing
- properties with a higher level of short-range variability.



Results

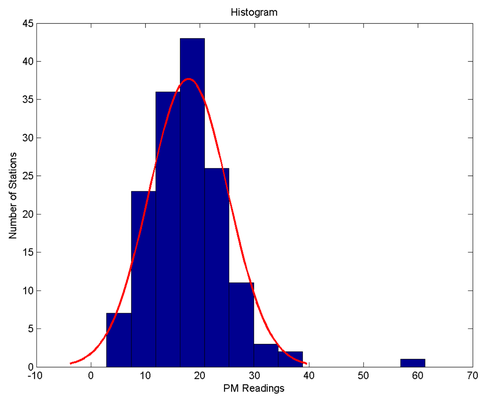


Fig. 1

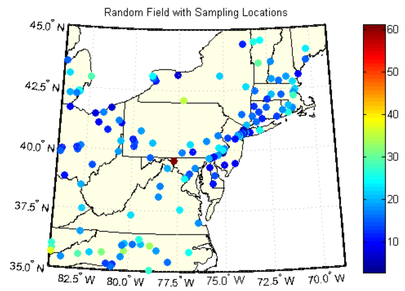


Fig. 2

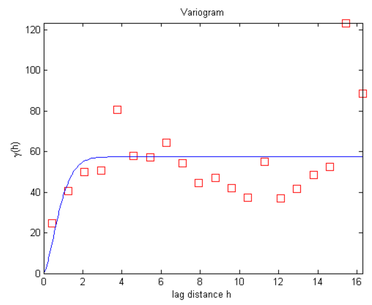


Fig. 3

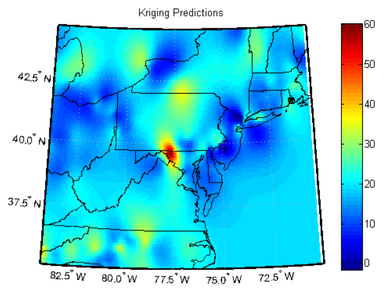


Fig. 4

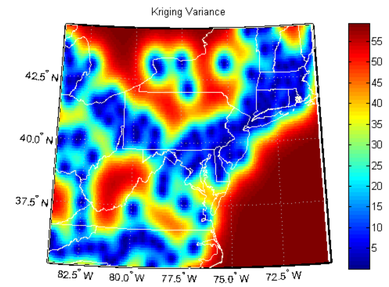
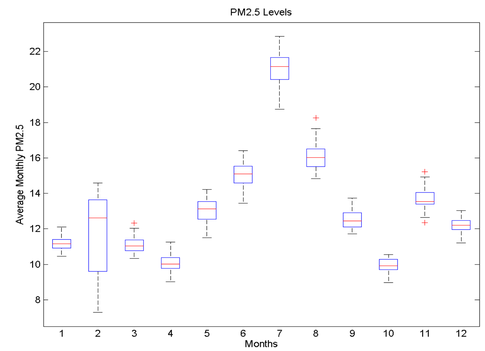
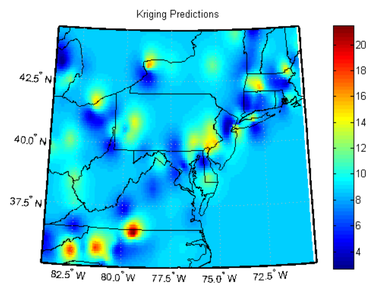
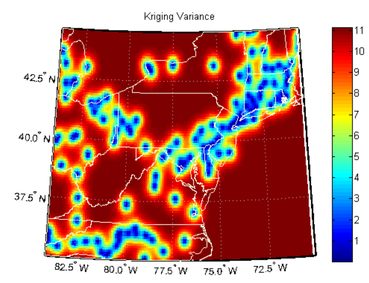


Fig. 5

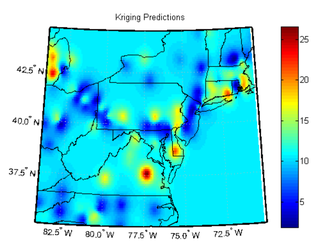
Fig. 1-5. July 9, 2008

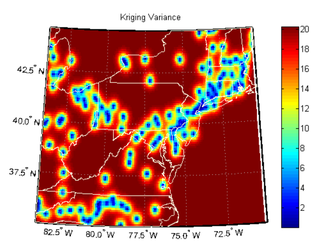






December 24, 2008





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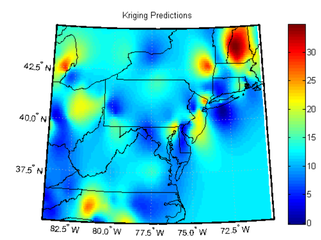

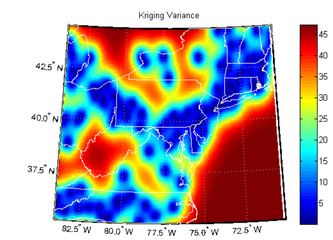

September 25, 2006

Summary and Conclusion

- The box plot demonstrates how PM2.5 levels are elevated during the summer months of June, July and August.
- We implemented kriging, specifically simple kriging, to obtain better spatial coverage for the point station measurements.
- We also obtained the estimation as well as variance for the PM2.5 measurement for the northeastern region of the United States.
- Furthermore, these products will enable us to obtain a fused data product, fusing together ground station data and satellite remote sensing estimates.

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